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\*          WELCOME TO THE          \*  
\*      U. S. PATENT TEXT FILE      \*  
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L1      4585 AIRBAG/Q

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L2      41 CERRIC (W) AMMONIUM (W) NITRATE OR CE (1W) NH (2W) NO

L3      0 L1 AND L2

L4      0 L2 AND AUTOIGNITION

L5      381 L1 AND COMPLEX

L6      203 COMPLEX (P) OXIDIZER

L7      21 L1 AND L6

L8      2 L7 AND AUTOIGNITION

*Parent* 1. 5,739,460, Apr. 14, 1998, Method of safely initiating combustion of a gas generant composition using an **\*\*autoignition\*\*** composition; Gregory D. Knowlton, et al., 102/324, 205; 149/45, 109.6; 280/741

2. 5,577,769, Nov. 26, 1996, Hybrid inflator for inflating air bags; Michael Di Giacomo, et al., 280/736, 737, 741

US PAT NO: 5,739,460          L8: 1 of 2

TITLE: Method of safely initiating combustion of a gas generant composition using an **\*\*autoignition\*\*** composition

ABSTRACT: The present invention relates to an **\*\*autoignition\*\*** composition for safely initiating combustion of a main pyrotechnic charge in a gas generator or pyrotechnic device exposed to flame or a high temperature environment. The **\*\*autoignition\*\*** compositions of the invention include a mixture of an **\*\*oxidizer\*\*** composition and a powdered metal, wherein the **\*\*oxidizer\*\*** composition includes at least one of an alkali metal or an alkaline earth metal nitrate, a **\*\*complex\*\*** salt nitrate, such as Ce(NH.sub.4).sub.2 (NO.sub.3).sub.6 or ZrO(NO.sub.3).sub.2, a dried, hydrated nitrate, such as Ca(NO.sub.3).sub.2 .multidot.4H.sub.2 O or Cu(NO.sub.3).sub.2 .multidot.2.5H.sub.2 O . . . environment. In the method of the invention, the gas generator or pyrotechnic composition is placed in thermal contact with an **\*\*autoignition\*\*** composition of the invention.

BSUM(18) The most preferred organic **\*\*autoignition\*\*** compositions include a mixture of silver nitrate, guanidine nitrate, and molybdenum. In such an **\*\*autoignition\*\*** composition, the amount of molybdenum may be varied to adjust the **\*\*autoignition\*\*** temperature. If the amount of molybdenum is greater than the stoichiometric amount, the **\*\*autoignition\*\*** temperature of the **\*\*autoignition\*\*** composition will decrease as the amount of molybdenum is increased.

L9      19 L7 NOT L8

3. 5,735,118, Apr. 7, 1998, Using metal complex compositions as gas generants; Jerald C. Hinshaw,

5. 5,725,699, Mar. 10, 1998, Metal complexes for use as gas generants; Jerald C. Hinshaw, et al.,  
7. 5,673,935, Oct. 7, 1997, Metal complexes for use as gas generants; Jerald C. Hinshaw, et al.,  
8. 5,592,812, Jan. 14, 1997, Metal complexes for use as gas generants; Jerald C. Hinshaw, et al.,  
  
11. 5,516,377, May 14, 1996, Gas generating compositions based on salts of 5-nitraminotetrazole;  
Thomas K. Highsmith, et al., 149/18, 19.1, 36, 62, 92, 109.2  
  
15. 5,472,647, Dec. 5, 1995, Method for preparing anhydrous tetrazole gas generant compositions;  
Reed J. Blau, et al., 264/3.1; 149/19.92, 109.6; 264/3.4  
  
16. 5,197,758, Mar. 30, 1993, Non-azide gas generant formulation, method, and apparatus; Gary K.  
Lund, et al., 280/741; 149/61  
  
17. 5,160,386, Nov. 3, 1992, Gas generant formulations containing poly(nitrito) metal complexes as  
oxidants and method; Gary K. Lund, et al., 149/88, 19.5, 35, 45, 109.4  
  
18. 3,964,255, Jun. 22, 1976, Method of inflating an automobile passenger restraint bag; Vincent  
Owen Catanzarite, 60/205; 149/75, 77, 109.2; 280/728.1  
  
19. 3,910,805, Oct. 7, 1975, Low temperature gas generating compositions; Vincent Owen  
Catanzarite, 149/83, 75, 76

US PAT NO: 5,735,118

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**ABSTRACT:** Gas . . . metal cation template, a neutral ligand containing hydrogen and nitrogen, and sufficient oxidizing anion to balance the charge of the **\*\*complex\*\***. The complexes are formulated such that when the **\*\*complex\*\*** combusts, nitrogen gas and water vapor is produced. Specific examples of such complexes include metal nitrite ammine, metal nitrate ammine, and metal perchlorate ammine complexes, as well as hydrazine complexes. A binder and co-**\*\*oxidizer\*\*** can be combined with the metal complexes to improve crush strength of the gas generating compositions and to permit efficient. . .

**BSUM(19)** The . . . a neutral ligand containing hydrogen and nitrogen. One or more oxidizing anions are provided to balance the charge of the **\*\*complex\*\***. Examples of typical oxidizing anions which can be used include nitrates, nitrites, chlorates, perchlorates, peroxides, and superoxides. In some cases the oxidizing anion is part of the metal cation coordination **\*\*complex\*\***. The complexes are formulated such that when the **\*\*complex\*\*** combusts, a mixture of gases containing nitrogen gas and water vapor are produced. A binder can be provided to improve the crush strength and other mechanical properties of the gas generant composition. A co-**\*\*oxidizer\*\*** can also be provided

**BSUM(64)** It . . . water, and a metal or metal oxide. However, for certain complexes it may be desirable to add a fuel or **\*\*oxidizer\*\*** to the **\*\*complex\*\*** in order to assure complete and efficient reaction. Such fuels include, for example, boron, magnesium, aluminum, hydrides of boron or. . .

**CLMS(1)** What . . . generating substantially non-toxic gas by combusting an at least essentially azide-free gas generating, composition containing at least one metal ammine **\*\*complex\*\*** having transition metal cation or alkaline earth metal cation and at least one neutral ligand comprised of ammonia, and sufficient. . . one additional ingredient which comprises:

- (i) carbon powder,
- (ii) a binder, or

(iii) up to about 50% by weight of an inorganic **\*\*oxidizer\*\***, such that

US PAT NO: 5,725,699

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ABSTRACT: Gas . . . metal cation template, a neutral ligand containing hydrogen and nitrogen, and sufficient oxidizing anion to balance the charge of the **\*\*complex\*\***. The complexes are formulated such that when the **\*\*complex\*\*** combusts, nitrogen gas and water vapor is produced. Specific examples of such complexes include metal nitrite ammine, metal nitrate ammine, and metal perchlorate ammine complexes, as well as hydrazine complexes. A binder and co-**\*\*oxidizer\*\*** can be

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CLMS(14) 14. A gas generating composition formulated from ingredients comprising: at least one **\*\*complex\*\*** of a metal cation ammonia ligand, and sufficient oxidizing anion to balance the charge of the metal **\*\*complex\*\***, wherein said composition contains about 50% to about 80% by weight of said **\*\*complex\*\*** and said anion; a binder and a co-**\*\*oxidizer\*\*** such that the binder has a

CLMS(30) 30. A gas generating composition as defined in claim 1, wherein the **\*\*complex\*\*** is hexaamminecobalt(III) nitrate,  $[(\text{NH}_3)_6\text{Co}](\text{NO}_3)_3$  and the co-**\*\*oxidizer\*\*** is copper(II) trihydroxy nitrate  $(\text{Cu}(\text{OH})_3\text{NO}_3)$ .

US PAT NO: 5,673,935

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BSUM(49) It . . . gas, and a metal or metal oxide. However, for certain complexes it may be desirable to add a fuel or **\*\*oxidizer\*\*** to the **\*\*complex\*\*** in order to assure complete and efficient reaction. Such fuels include, for example, boron, magnesium, aluminum, hydrides of boron or. . .

CLMS(1) What . . . deploying an air bag or balloon from a supplemental safety restraint system, said gas generating composition comprising at least one **\*\*complex\*\*** of a transition metal or alkaline earth metal cation, at least one neutral ligand comprising ammonia, and sufficient

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BSUM(24) In . . . tungsten, such as  $\text{CuO}$ ,  $\text{MnO}_2$ ,  $\text{Co}_2\text{O}_3$ ,  $\text{Co}_3\text{O}_4$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{MoO}_3$ ,  $\text{Bi}_2\text{MoO}_6$ ,  $\text{Bi}_2\text{O}_3$ ,  $\text{Bi}(\text{OH})_3$ , and  $\text{Cu}(\text{OH})_2$ . The **\*\*oxidizer\*\*** can be an inorganic nitrate or nitrite such as lead nitrate, tin nitrate,  $\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{NO}_2$ ,  $\text{KClO}_4$ ,  $\text{KNO}_3$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ , or  $\text{Sr}(\text{NO}_3)_2$ . **\*\*Complex\*\*** metal nitrite and nitrate anions may also be used, of which  $\text{Co}(\text{NO}_2)_6$ ,  $\text{Cu}(\text{NO}_2)_4$ , and  $\text{Zn}(\text{NO}_2)_4$  are illustrative. The oxidizers can.

ABSTRACT: Gas generating compositions or propellants are provided which comprise a fuel and a novel **\*\*oxidizer\*\*** therefor comprising an inorganic compound having a **poly(nitrito) transition metal \*\*complex\*\* anion**. The inorganic oxidant compounds are generically represented by the formula:

$M_{\text{sub}.x.\text{sup}.1} M_{\text{sub}.y.\text{sup}.2} (\text{NO}_{\text{sub}.2})_{\text{sub}.z}$  wherein (1)  $M_{\text{sup}.1}$  is a metal. . .

BSUM(22) where . . . or 4;  $y=1$  or 2 and  $z=4$  or 6, as determined by the required stoichiometry of the metals of the **\*\*complex\*\***, and the  $M_{\text{sup}.1}$  and  $M_{\text{sup}.2}$  metal must not be the same metal.  $M_{\text{sup}.1}$  is preferably an alkali metal, most preferably potassium. Potassium hexanitrocobaltate,  $\text{K}_{\text{sub}.3} \text{Co}(\text{NO}_{\text{sub}.2})_{\text{sub}.6}$ , is the most preferred example of an **\*\*oxidizer\*\***.

DETD(2) The . . . relates to solid gas generant or propellant compositions containing as essential ingredients: (1) a gas generating fuel and (2) an **\*\*oxidizer\*\*** therefor, wherein the **\*\*oxidizer\*\*** comprises an inorganic compound having a poly(nitrito) transition metal **\*\*complex\*\* anion**. This **\*\*complex\*\* anion** may be associated with any stable cation having a valence of up to two chosen

DETD(4) wherein . . . or 4;  $y=1$  or 2; and  $z=4$  or 6 as determined by the required stoichiometry of the metals of the **\*\*complex\*\***, and (4) the  $M_{\text{sup}.1}$  and  $M_{\text{sup}.2}$  metals selected are different metals.  $M_{\text{sup}.1}$  is preferably an alkali or alkaline earth metal, most preferably potassium. The most preferred **\*\*oxidizer\*\* salt** is potassium hexanitrocobaltate,  $\text{K}_{\text{sub}.3} \text{Co}(\text{NO}_{\text{sub}.2})_{\text{sub}.6}$ .

DETD(6) The use of oxidizers (2) having poly(nitrito) transition metal **\*\*complex\*\* anions**, e.g.  $\text{K}_{\text{sub}.3} \text{Co}(\text{NO}_{\text{sub}.2})_{\text{sub}.6}$ , has been demonstrated with non-azide gas generator fuels, e.g.  $\text{C}_{\text{sub}.4} \text{H}_{\text{sub}.2} \text{N}_{\text{sub}.3} \text{O}_{\text{sub}.5} \text{K}$  and  $\text{C}_{\text{sub}.2}$ . . . combustion with a reasonable burning rate as shown in Example 1A and 1B, respectively. The potassium salt of the  $\text{Co}(\text{NO}_{\text{sub}.2})_{\text{sub}.6.\text{sup}.3}$  **\*\*complex\*\*** is preferred because it is neither water soluble nor hygroscopic. These properties, i.e. water insoluble and anhydrous, prevent excessive introduction. . . in significantly lower flame temperatures for the

BSUM(25) As . . . performance of the gas generator system for a passenger restraint bag, involves the non-gaseous products of the reaction between the **\*\*oxidizer\*\*** compound and the oxygen bearing metal organic compound. The reaction typically produces a metal oxide and when the chlorates or . . . metal salts alone. The binary mixtures of metal oxide and metal chloride, have particularly low melting points and combinations of **\*\*oxidizer\*\*** and metal organic compound yielding such a mixture upon reaction are preferred. If oxidizers are used that do not yield a metal chloride, it is preferred that different metal ions be present in at least part of the **\*\*oxidizer\*\*** and metal organic. This assures at least a binary mixture of metal salts for getting a melting point lower than either metal salt alone. Ternary or more **\*\*complex\*\* mixtures** of metal salts may be used for low melting.

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L10 1142 HYDRATE# (3A) NITRATE#

L11 6 L1 AND L10

1. 5,739,460, Apr. 14, 1998, Method of safely initiating combustion of a gas generant composition using an autoignition composition; Gregory D. Knowlton, et al., 102/324, 205; 149/45, 109.6;
2. 5,735,118, Apr. 7, 1998, Using metal complex compositions as gas generants; Jerald C. Hinshaw, et al., 60/219; 149/45; 280/741
3. 5,725,699, Mar. 10, 1998, Metal complexes for use as gas generants; Jerald C. Hinshaw, et al., 149/19.1, 45, 75; 280/741
4. 5,656,793, Aug. 12, 1997, Gas generator compositions; Koji Ochi, et al., 149/22, 36, 37, 61, 75, 108.2
5. 5,516,377, May 14, 1996, Gas generating compositions based on salts of 5-nitraminotetrazole; Thomas K. Highsmith, et al., 149/18, 19.1, 36, 62, 92, 109.2
6. 5,429,691, Jul. 4, 1995, Thermite compositions for use as gas generants comprising basic metal carbonates and/or basic metal nitrates; Jerald C. Hinshaw, et al., 149/45, 22, 37; 280/728.1

US PAT NO: 5,735,118

L11: 2 of 6

BSUM(73) The . . . metal carbonate hydroxide oxides, and hydrates and mixtures thereof and a basic metal nitrate such as metal hydroxide nitrates, metal **\*\*nitrate\*\*** oxides, and **\*\*hydrates\*\*** and mixtures thereof, including those oxidizers described in U.S. Pat. No. 5,429,691, titled "Thermite

US PAT NO: 5,725,699

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BSUM(73) The . . . metal carbonate hydroxide oxides, and hydrates and mixtures thereof and a basic metal nitrate such as metal hydroxide nitrates, metal **\*\*nitrate\*\*** oxides, and **\*\*hydrates\*\*** and mixtures thereof, including those oxidizers described in U.S. Pat. No. 5,429,691, titled "Thermite

US PAT NO: 5,656,793

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ABSTRACT: A . . . generator includes a flame coolant containing at least one compound selected from the group consisting of hydrates of metal sulfates, **\*\*hydrates\*\*** of metal **\*\*nitrates\*\***, **\*\*hydrates\*\*** of metal carbonates, metal hydroxides, and hydrates of metal hydroxides in which

DETD(22) The flame coolant, a compound which causes an endothermic decomposition reaction, is selected from the following group hydrates of metal sulfate: **\*\*hydrates\*\*** of metal **\*\*nitrates\*\***, metal

carbonates, **\*\*hydrates\*\*** of metal carbonates, metal hydroxide and hydrates of metal hydroxide, in which the metal moieties are selected from the III, . . . V and VI Period metals of the Periodic Table. Of these hydrates, the preferred compounds are hydrates of metal sulfates, **\*\*hydrates\*\*** of metal **\*\*nitrates\*\***, metal carbonates, **\*\*hydrates\*\*** of metal carbonates, metal hydroxides and hydrates of metal hydroxide, in which the metal moieties are selected from the III. . .

CLMS(4) CLMS(10)

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DETD(10) Zinc nitraminotetrazole was obtained in a manner analogous to Example 2 using, zinc acetate or zinc **\*\*nitrate\*\*** **\*\*hydrate\*\*** instead of ZnCl.sub.2.

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DETD(2) The . . . carbonate hydroxides, metal carbonate oxides, and hydrates thereof. As used herein, a basic metal nitrate includes metal nitrate hydroxides, metal **\*\*nitrate\*\*** oxides, and **\*\*hydrates\*\*** thereof. The fuel and the oxidizing agent combination is selected with the proviso that substantially nontoxic gaseous reaction products, such. . .

DETD(10) (a) It is a basic metal carbonate, basic metal **\*\*nitrate\*\***, or **\*\*hydrate\*\*** thereof.

DETD(12) Given . . . oxides, metal carbonate hydroxide oxides, and hydrates and mixtures thereof and basic metal nitrates such as metal hydroxide nitrates, metal **\*\*nitrate\*\*** oxides, and **\*\*hydrates\*\*** and mixtures thereof wherein the metal species therein can be at least one species

CLMS(15) 15. . . . composition according to claim 1, wherein the oxidizing agent is a basic metal nitrate selected from metal nitrate hydroxides, metal **\*\*nitrate\*\*** oxides, and **\*\*hydrates\*\*** and

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